

PATENT COOPERATION TREATY

PCT

NOTIFICATION OF THE RECORDING
OF A CHANGE(PCT Rule 92bis.1 and
Administrative Instructions, Section 422)

From the INTERNATIONAL BUREAU

To:

MURGITROYD & COMPANY
373 Scotland Street
Glasgow G5 8QA
ROYAUME-UNI

| | |
|---|---|
| Date of mailing (day/month/year) 10 August 2000 (10.08.00) | IMPORTANT NOTIFICATION International filing date (day/month/year) 20 October 1999 (20.10.99) |
| Applicant's or agent's file reference P20188A/LLO/NHE | |
| International application No. PCT/GB99/03476 | |

1. The following indications appeared on record concerning:

☒ the applicant ☐ the inventor ☐ the agent ☐ the common representative

Name and Address

JIM LINDSAY LIMITED
13 Hill Street
Ardrossan KA22 8HE
United Kingdom

State of Nationality

GB

State of Residence

GB

Telephone No.

Facsimile No.

Teleprinter No.

2. The International Bureau hereby notifies the applicant that the following change has been recorded concerning:

☐ the person ☐ the name ☒ the address ☐ the nationality ☐ the residence

Name and Address

JIM LINDSAY LIMITED
Marlin House
12 Heatherhouse Road
Heatherhouse Industrial Estate
Irvine KA12 8HQ
United Kingdom

State of Nationality

GB

State of Residence

GB

Telephone No.

Facsimile No.

Teleprinter No.

3. Further observations, if necessary:

4. A copy of this notification has been sent to:

| | |
|---|---|
| <input checked="" type="checkbox"/> the receiving Office | <input type="checkbox"/> the designated Offices concerned |
| <input type="checkbox"/> the International Searching Authority | <input checked="" type="checkbox"/> the elected Offices concerned |
| <input checked="" type="checkbox"/> the International Preliminary Examining Authority | <input type="checkbox"/> other: |

| | |
|---|--|
| The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No.: (41-22) 740.14.35 | Authorized officer R. Chrem Telephone No.: (41-22) 338.83.38 |
|---|--|



PCT

NOTIFICATION OF ELECTION

(PCT Rule 61.2)

From the INTERNATIONAL BUREAU

To:

Assistant Commissioner for Patents
United States Patent and Trademark
Office
Box PCT
Washington, D.C.20231
ETATS-UNIS D'AMERIQUE

in its capacity as elected Office

| | |
|---|---|
| Date of mailing (day/month/year) 16 June 2000 (16.06.00) | |
| International application No. PCT/GB99/03476 | Applicant's or agent's file reference P20188A/LLO/NHE |
| International filing date (day/month/year) 20 October 1999 (20.10.99) | Priority date (day/month/year) 22 October 1998 (22.10.98) |
| Applicant LINDSAY, James et al | |

1. The designated Office is hereby notified of its election made:



in the demand filed with the International Preliminary Examining Authority on:

18 May 2000 (18.05.00)



in a notice effecting later election filed with the International Bureau on:

2. The election ☒ was

was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No.: (41-22) 740.14.35

Authorized officer

Olivia RANAIVOJAONA

Telephone No.: (41-22) 338.83.38

From the
INTERNATIONAL PRELIMINARY EXAMINING AUTHORITY

CORRECTED VERSION

To:

Murgitroyd & Company
373 Scotland Street
Glasgow G5 8QA
GRANDE BRETAGNE

PCT

NOTIFICATION OF TRANSMITTAL OF
THE INTERNATIONAL PRELIMINARY
EXAMINATION REPORT

(PCT Rule 71.1)

Date of mailing
(day/month/year) 09.03.2001

Applicant's or agent's file reference
P20188A/GMM/NHE

IMPORTANT NOTIFICATION

International application No.
PCT/GB99/03476

International filing date (day/month/year)
20/10/1999

Priority date (day/month/year)
22/10/1998

Applicant
JIM LINDSAY LIMITED et al.

1. The applicant is hereby notified that this International Preliminary Examining Authority transmits herewith the international preliminary examination report and its annexes, if any, established on the international application.
2. A copy of the report and its annexes, if any, is being transmitted to the International Bureau for communication to all the elected Offices.
3. Where required by any of the elected Offices, the International Bureau will prepare an English translation of the report (but not of any annexes) and will transmit such translation to those Offices.

4. REMINDER

The applicant must enter the national phase before each elected Office by performing certain acts (filing translations and paying national fees) within 30 months from the priority date (or later in some Offices) (Article 39(1)) (see also the reminder sent by the International Bureau with Form PCT/IB/301).

Where a translation of the international application must be furnished to an elected Office, that translation must contain a translation of any annexes to the international preliminary examination report. It is the applicant's responsibility to prepare and furnish such translation directly to each elected Office concerned.

For further details on the applicable time limits and requirements of the elected Offices, see Volume II of the PCT Applicant's Guide.

* Please find herewith a CORRECTED version of the International Preliminary Examination Report which replaces the one sent to you on 02.02.2001

Name and mailing address of the IPEA/



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NL-2280 HV Rijswijk - Pays Bas
Tel. +31 70 340 - 2040 Tx: 31 651 epo nl
Fax: +31 70 340 - 3016

Authorized officer

Daniels, H

Tel.+31 70 340-3718



INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

| | | |
|--|---|--|
| Applicant's or agent's file reference P20188A/GMM/NHE | FOR FURTHER ACTION See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416) | |
| International application No. PCT/GB99/03476 | International filing date (day/month/year) 20/10/1999 | Priority date (day/month/year) 22/10/1998 |
| International Patent Classification (IPC) or national classification and IPC B05B7/10 | | |
| Applicant JIM LINDSAY LIMITED et al. | | |

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 6 sheets, including this cover sheet.


☒ This report is also accompanied by ANNEXES, i.e. sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

These annexes consist of a total of 3 sheets.

3. This report contains indications relating to the following items:

- I ☒ Basis of the report
- II ☐ Priority
- III ☐ Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
- IV ☒ Lack of unity of invention
- V ☒ Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
- VI ☐ Certain documents cited
- VII ☒ Certain defects in the international application
- VIII ☒ Certain observations on the international application

**CORRECTED
VERSION**

| | |
|---|--|
| Date of submission of the demand 18/05/2000 | Date of completion of this report 09.03.2001 |
| Name and mailing address of the international preliminary examining authority:  European Patent Office - P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Tx: 31 651 epo nl Fax: +31 70 340 - 3016 | Authorized officer Guastavino, L Telephone No. +31 70 340 2867 |



INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/GB99/03476

I. Basis of the report

1. This report has been drawn on the basis of *(substitute sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to the report since they do not contain amendments (Rules 70.16 and 70.17).)*

Description, pages:

1-17 as originally filed

Claims, No.:

1-4, 17 (part), 18-22, as originally filed
23 (part), 27-32

5-16, 17 (part), 23 (part), as received on 03/01/2001
with letter of 29/12/2000
24-26

Drawings, sheets:

1/8-8/8 as originally filed

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language: , which is:

- ☐ the language of a translation furnished for the purposes of the international search (under Rule 23.1(b)).
- ☐ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of a translation furnished for the purposes of international preliminary examination (under Rule 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

**INTERNATIONAL PRELIMINARY
EXAMINATION REPORT**

International application No. PCT/GB99/03476

4. The amendments have resulted in the cancellation of:

- ☐ the description, pages:
- ☐ the claims, Nos.:
- ☐ the drawings, sheets:

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed (Rule 70.2(c)):

(Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report.)

6. Additional observations, if necessary:

IV. Lack of unity of invention

1. In response to the invitation to restrict or pay additional fees the applicant has:

- ☒ restricted the claims.
- ☐ paid additional fees.
- ☐ paid additional fees under protest.
- ☐ neither restricted nor paid additional fees.

2. ☐ This Authority found that the requirement of unity of invention is not complied and chose, according to Rule 68.1, not to invite the applicant to restrict or pay additional fees.

3. This Authority considers that the requirement of unity of invention in accordance with Rules 13.1, 13.2 and 13.3 is

- ☒ complied with.
- ☐ not complied with for the following reasons:

4. Consequently, the following parts of the international application were the subject of international preliminary examination in establishing this report:

- ☐ all parts.
- ☒ the parts relating to claims Nos. 10-32.

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No. PCT/GB99/03476

| | | | |
|-------------------------------|------|--------|-------|
| Novelty (N) | Yes: | Claims | 10-32 |
| | No: | Claims | |
| Inventive step (IS) | Yes: | Claims | 10-32 |
| | No: | Claims | |
| Industrial applicability (IA) | Yes: | Claims | 10-32 |
| | No: | Claims | |

2. Citations and explanations
see separate sheet

VII. Certain defects in the international application

The following defects in the form or contents of the international application have been noted:
see separate sheet

VIII. Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:
see separate sheet

R l t m V

Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Document US-A-3970221 (D1, see search report) describes a apparatus, also for spraying liquid surface treatment material, said apparatus comprising a housing (21), a liquid inlet (56) for supply of the liquid surface treatment material; a gas inlet (58) for the supply of pressurised gas to be mixed with the liquid treatment material; an outlet nozzle (86, 88) through which the gas and liquid surface treatment material is sprayed; a control valve (66) adapted to regulate the supply of the liquid material to the outlet nozzle, a gas valve (66) operable between an open position and a closed position; a first passageway (62) connecting said gas inlet to said gas valve (66); a second passageway (62') connecting said valve (66) to said outlet nozzle wherein said second passageway (62') is axially offset (see fig. 2) from said first passageway and is substantially conical in shape and said second passageway is tapered from said inlet to said outlet.

Document D1, which is considered to represent the most relevant state of the art w.r.t. claim 10, thus discloses a device from which the subject-matter of claim 10 differs by "an angle of taper of between 1 and 15°" and by the fact that the second passageway "outwardly tapers" from said inlet to said outlet, whereby the subject-matter of claims 10-24 is considered as being novel.

The problem to be solved by the combination of these features with the axially offset passageways might be seen as achieving a high air speed at the nozzle whilst using low air pressure at the inlet.

This combination of features is not known or derivable from the available prior art, and solves the above mentioned problem by allowing further acceleration (in the tapering portion) of the vortex created by the axially offset configuration.

Therefore, the subject-matter of claim 10, and therefore of claims 11-24, is considered to present inventive step.

2. The combination of features of claim 25 differs from the prior art document US-A-4232832 (D2; see search report) wherein a vortex is also created (see Fig. 7 of D2) by the provision of an outwardly tapering portion.

This outwardly tapering portion is not known or derivable from the available prior art, and solves the above mentioned problem by allowing further acceleration (in the tapering portion) of the vortex, thus allowing a proper atomisation to take place (relatively high tangential velocities in the vortex) even with low pressure propellant.

The subject-matter of claims 25-32 is therefore considered to present the required novelty and inventive step.

Re Item VII

Certain defects in the international application

1. Contrary to the requirements of Rule 5.1(a)(ii) PCT, the relevant background art disclosed in the documents D1 and D2 is not mentioned in the description, nor are this/these document/s identified therein.
2. The description is not in conformity with the claims as required by Rule 5.1(a)(iii) PCT (cf. deletion of original claims 1-9).
3. Independent claim 10 and 25 are not in the two-part form in accordance with Rule 6.3(b) PCT, which in the present case would have been appropriate, with those features known in combination from the prior art (document D1 or D2, see above) being placed in the preamble (Rule 6.3(b)(i) PCT) and with the remaining features being included in the characterising part (Rule 6.3(b)(ii) PCT).
4. The features of the claims are not provided with reference signs placed in parentheses (Rule 6.2(b) PCT).

Re Item VIII

Certain observations on the international application

1. The vague and imprecise statement in the description on page 17, last paragraph implies that the subject-matter for which protection is sought may be different to that defined by the claims, thereby resulting in lack of clarity (Article 6 PCT) when used to interpret them (see also the PCT Guidelines, III-4.3a).

03. 01. 2001

19

(42)

5. An apparatus according to Claim 4, wherein said taper is between 1 to 15°.
6. An apparatus according to either Claim 4 or Claim 5, wherein said second passageway has a radius of curvature at said outlet so as to provide gas to the outlet nozzle in a substantially horizontal direction.
7. An apparatus according to any preceding claim, wherein said stepped portion of said second passageway comprises a ledge whose width tapers up to a maximum of 10% of the radius of said second passageway at the level of the stepped portion.
8. An apparatus according to Claim 7, wherein the longitudinal axis of said outlet nozzle extends across said second passageway.
9. An apparatus according to Claim 8, wherein the axis of symmetry of said ledge is offset from said longitudinal axis of said outlet nozzle.
10. An apparatus for spraying liquid surface treatment material, said apparatus comprising:
- a housing;
 - a liquid inlet for supply of the liquid surface treatment material;
 - a gas inlet for supply of pressurised gas to be mixed with the liquid surface treatment material;
 - an outlet nozzle through which the gas and liquid surface treatment material is sprayed;
 - a control valve adapted to regulate the supply of the liquid surface treatment material to the outlet nozzle;
 - a gas valve operable between an open position and a closed position;

1 a first communicating passageway connecting said
2 gas inlet to said gas valve; and

3 a second communicating passageway connecting said
4 gas valve to said outlet nozzle;

5 wherein said second passageway is axially offset
6 from said first passageway and is substantially conical
7 in shape, and wherein said second passageway includes
8 an inlet and an outlet and outwardly tapers from said
9 inlet to said outlet at an angle of taper of between 1
10 and 15°.

11
12 11. An apparatus according to any preceding claim,
13 further comprising a trigger means;

14 whereby said trigger means is adapted to operate
15 both of said control valve and said gas valve.

16
17 12. An apparatus according to Claim 11, wherein said
18 control valve is a liquid control needle valve.

19
20 13. An apparatus according to Claim 12, wherein said
21 gas valve is an axially-sliding piston valve.

22
23 14. An apparatus according to Claim 13, wherein said
24 outlet nozzle is controlled by said liquid control
25 needle valve.

26
27 15. An apparatus according to either Claim 13 or Claim
28 14, wherein said piston valve produces an annular air
29 jet in said second passageway.

30
31 16. An apparatus according to any of Claims 13 to 15,
32 further comprising an air control valve stem which is
33 connected to said piston valve and operated by said
34 trigger means.

35
36 17. An apparatus according to any of Claims 13 to 16,

1 supplied with a liquid by said gravity liquid
2 reservoir.

3
4 24. An apparatus according to any preceding claim,
5 further comprising a regulating valve and a pair of
6 side jets, whereby the spray pattern of the outlet
7 nozzle is regulated by said regulating valve, and said
8 side jets are utilised to regulate said spray pattern.

9
10 25. A method of spraying a liquid onto a surface, said
11 method comprising the steps of:

12 supplying a liquid to be sprayed into a liquid
13 inlet of a spray apparatus;

14 supplying a pressurised gaseous propellant into a
15 gas inlet of said spray apparatus;

16 passing said gaseous propellant through a
17 communicating passageway from said gas inlet to an
18 outlet nozzle;

19 accelerating said gaseous propellant by creating a
20 gas vortex as said propellant passes through said
21 communicating passageway;

22 passing said accelerated propellant through an
23 outwardly tapering portion of the communicating
24 passageway to further accelerate the vortex and supply
25 the propellant to the outlet nozzle in the form of an
26 annular gas jet, the portion tapering outwardly in the
27 direction of propellant flow; and

28 spraying said liquid onto a surface by mixing said
29 liquid and said annular gas jet at said nozzle.

30
31 26. A method according to Claim 25, wherein said
32 passageway comprises an upper portion and a lower
33 portion, wherein said upper portion is axially offset
34 from said lower portion and is substantially conical in
35 shape.

36

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INTERNATIONAL SEARCH REPORT

(PCT Article 18 and Rules 43 and 44)

| | | |
|---|---|--|
| Applicant's or agent's file reference P20188A/LLO/NHE | FOR FURTHER ACTION see Notification of Transmittal of International Search Report (Form PCT/ISA/220) as well as, where applicable, item 5 below. | |
| International application No. PCT/GB 99/ 03476 | International filing date (day/month/year) 20/10/1999 | (Earliest) Priority Date (day/month/year) 22/10/1998 |
| Applicant JIM LINDSAY LIMITED et al. | | |

This International Search Report has been prepared by this International Searching Authority and is transmitted to the applicant according to Article 18. A copy is being transmitted to the International Bureau.

This International Search Report consists of a total of 5 sheets.



It is also accompanied by a copy of each prior art document cited in this report.

N.B.: Copies of the prior art documents for the first subject have already been sent to you

1. Basis of the report

- a. With regard to the **language**, the international search was carried out on the basis of the international application in the language in which it was filed, unless otherwise indicated under this item.



the international search was carried out on the basis of a translation of the international application furnished to this Authority (Rule 23.1(b)).

- b. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, the international search was carried out on the basis of the sequence listing :



contained in the international application in written form.



filed together with the international application in computer readable form.



furnished subsequently to this Authority in written form.



furnished subsequently to this Authority in computer readable form.



the statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.



the statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

2. ☐ **Certain claims were found unsearchable** (See Box I).

3. ☒ **Unity of invention is lacking** (see Box II).

4. With regard to the title,



the text is approved as submitted by the applicant.



the text has been established by this Authority to read as follows:

5. With regard to the abstract,



the text is approved as submitted by the applicant.



the text has been established, according to Rule 38.2(b), by this Authority as it appears in Box III. The applicant may, within one month from the date of mailing of this international search report, submit comments to this Authority.

6. The figure of the **drawings** to be published with the abstract is Figure No.



as suggested by the applicant.



because the applicant failed to suggest a figure.



because this figure better characterizes the invention.

6a _____



None of the figures.

Box I Observations where certain claims were found unsearchable (Continuation of Item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:

2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:

3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of Item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☒ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☒ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claims: 1-9, 11-23

apparatus for spraying liquid with a gas and a liquid circuit, wherein a first passageway leads from the gas inlet to a gas valve and a second passageway connects the gas valve to the gas outlet and wherein the second passageway is provided with a STEPPED PORTION so that a gas vortex is created therethrough (claim 11-23 have been searched only as dependent on claims 1-9)

2. Claims: 10, 24-32

apparatus for spraying liquid with a gas and a liquid circuit, wherein a first passageway leads from the gas inlet to a gas valve and a second passageway connects the gas valve to the gas outlet and wherein the second passageway is axially OFFSET from the first passageway, and is CONICAL in shape, and is TAPERED between the inlet and the outlet of said passageway at an angle of taper of between 1 and 15°;

Method of spraying using such a tapering portion

A. CLASSIFICATION OF SUBJECT MATTER
IPC 7 B05B7/10 B05B7/12

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
IPC 7 B05B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category * | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|------------|--|-----------------------|
| X | ✓ US 3 970 221 A (FLEISCHER) 20 July 1976 (1976-07-20) | 1-4,6,11 |
| A | column 4, line 16 - line 45; figures 2,3 | 5,7,12 |
| A | ✓ WO 94 13404 A (ROBINSON) 23 June 1994 (1994-06-23) | 1,4,12 |
| A | ✓ abstract; figures 1,3,5 | |
| A | ✓ US 4 185 778 A (DRLIK) 29 January 1980 (1980-01-29) | 1 |
| X | ✓ US 4 232 832 A (DE FUSCO) 11 November 1980 (1980-11-11) | 25,26,28 |
| A | abstract; figure 7 | 10,24, 27,29-32 |
| | column 3, paragraph 5 | |
| | —/— | |

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

* Special categories of cited documents :

- *A* document defining the general state of the art which is not considered to be of particular relevance
- *E* earlier document but published on or after the international filing date
- *L* document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
- *O* document referring to an oral disclosure, use, exhibition or other means
- *P* document published prior to the international filing date but later than the priority date claimed

- *T* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- *X* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- *Y* document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- *&* document member of the same patent family

Date of the actual completion of the international search

25 May 2000

Date of mailing of the international search report

13. 06 2000

Name and mailing address of the ISA

European Patent Office, P.B. 5818 Patentlaan 2
NL - 2280 HV Rijswijk
Tel. (+31-70) 340-2040, Tx. 31 651 epo nl,
Fax: (+31-70) 340-3016

Authorized officer

Guastavino, L

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

| Category * | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|------------|--|-----------------------|
| A | ✓ US 3 796 376 A (FARNSTEINER) 12 March 1974 (1974-03-12) column 1, line 49 -column 2, line 60; figures 1,5 --- | 10,24, 25,28,29 |
| A | ✓ EP 0 389 657 A (MATTSON) 3 October 1990 (1990-10-03) abstract; figure 1 --- | 10,29 |
| A | ✓ EP 0 634 224 A (WAGNER) 18 January 1995 (1995-01-18) abstract column 3, line 5 -column 4, line 8; figures 1,3 ----- | 10,27 |

INTERNATIONAL SEARCH REPORT

Information on patent family members

International Application No

PCT/GB 99/03476

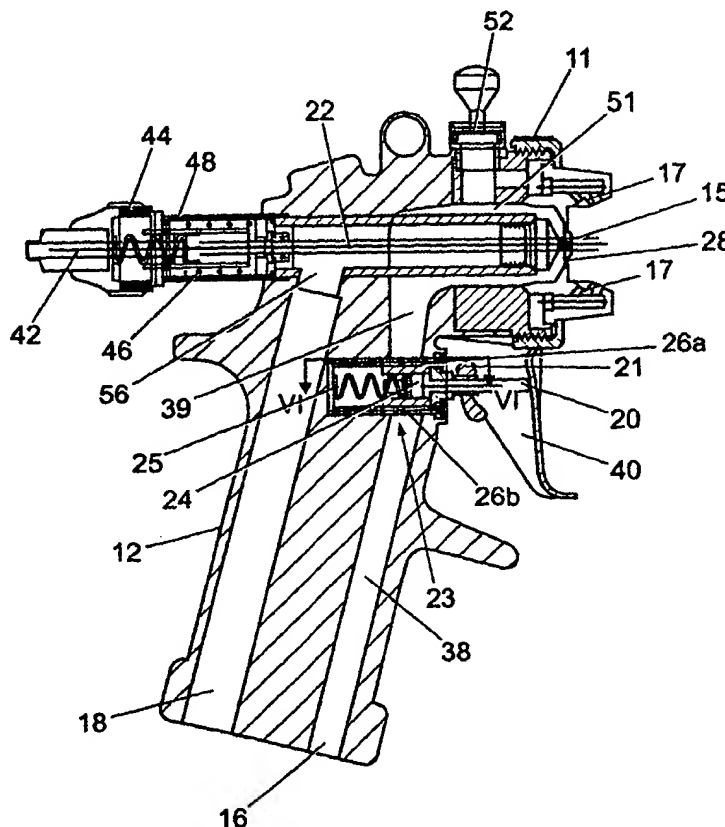
| Patent document cited in search report | | Publication date | Patent family member(s) | Publication date |
|---|---|---------------------|----------------------------|---------------------|
| US 3970221 | A | 20-07-1976 | US 3880333 A | 29-04-1975 |
| WO 9413404 | A | 23-06-1994 | AU 5657094 A | 04-07-1994 |
| US 4185778 | A | 29-01-1980 | NONE | |
| US 4232832 | A | 11-11-1980 | CH 623751 A | 30-06-1981 |
| | | | DE 2854639 A | 28-06-1979 |
| | | | FR 2412352 A | 20-07-1979 |
| US 3796376 | A | 12-03-1974 | FR 2194135 A | 22-02-1974 |
| | | | GB 1359439 A | 10-07-1974 |
| | | | AU 468173 B | 08-01-1976 |
| | | | AU 4901372 A | 23-05-1974 |
| | | | CA 979401 A | 09-12-1975 |
| | | | JP 919746 C | 22-08-1978 |
| | | | JP 49108613 A | 16-10-1974 |
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(54) Title: METHOD AND APPARATUS FOR SPRAYING**(57) Abstract**

A low volume-low pressure spray gun (10) for spraying a fluid has a housing (12), a gas input (16), a trigger valve mechanism, and a nozzle (14). The gun (10) has lower and upper air passages (38, 39) which connect the gas input (16) to the trigger valve mechanism (23), and the trigger valve mechanism to the nozzle (14), respectively. The upper passage (39) is offset from the lower passage (38) and is substantially conical in shape, the layout of the passages (38, 39) producing a gas vortex in the upper passage (39) which creates a gas acceleration to compensate for the low pressure of the gas entering the gas input (16). The trigger valve mechanism comprises a piston valve (23), a liquid control needle valve (22), and a trigger (40). The piston valve (23) may include inner and outer apertured sleeves (26a, 26b), the sleeves being co-axial with the inner sleeve (26a) located inside the outer sleeve (26b). The inner sleeve (26a) is rotatably adjustable relative to the outer sleeve (26b) so that the apertures (61, 62) of the sleeves (26a, 26b) may be aligned, partially aligned, or closed, thus permitting adjustment of the gas vortex.



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1 METHOD AND APPARATUS FOR SPRAYING

2
3 The present invention relates to a method and apparatus
4 for low air pressure spraying. Particularly, but not
5 exclusively, the invention is applicable to spray guns
6 for the application of paint and like material surface
7 treatments, particularly water-based paints.

8
9 The use of spray guns for application of paints is well
10 known. However, it has been found that when water-
11 based, high gloss paints are sprayed through a high
12 pressure or conventional spray gun, the level of gloss
13 is reduced. This is also true of the high volume-low
14 pressure type of spray gun which operate at only 10psi
15 air cap pressure.

16
17 Tests carried out at various pressures have shown that
18 the loss of gloss is due to air bubbles rising to the
19 surface of the paint as it dries. It has been found
20 that the greater the pressure used to spray the paint,
21 the more air bubbles appear. The cause of the bubbles
22 is that dissolved air is being released from the water
23 as the paint dries. The greater the air pressure when
24 the paint is sprayed, the greater the volume of
25 dissolved air and the greater the number of bubbles.

1 If the air pressure is low but the volume is high,
2 gloss levels are reduced. To achieve the desired gloss
3 levels with this type of paint it is necessary to
4 design a spray gun that will operate at very low air
5 pressures and very low air volumes. It must achieve
6 acceptable levels of atomization, have sufficient
7 energy to transfer the paint at an acceptable rate to
8 the surface of the target, and expand the natural cone
9 of spray into a useful fan pattern.

10
11 In the past, spray guns have used air pressures between
12 40 and 90 psi, and these high pressures cause a cushion
13 of air to be formed on the surface of the product being
14 treated. This cushion causes some of the sprayed
15 material to bounce back and be displaced laterally by
16 the following airflow to be lost in the surrounding
17 air.

18
19 Accordingly, this type of spray gun is very
20 inefficient. Rarely are transfer efficiencies greater
21 than 40% and more often nearer 30%. The waste paint
22 material produces unacceptable emissions of volatile
23 organic compounds and leaves a solid residue which can
24 remain floating in the air for some time. These can be
25 highly toxic and damaging to the atmosphere and health.
26 To overcome these problems, it is necessary to reduce
27 the air pressure and air volume used in such guns.
28 Therefore, the environmental requirements for an
29 acceptable spray gun are similar to those required for
30 achieving a good gloss in water-based paints.

31
32 If the air pressure is reduced on a spray gun that was
33 originally designed for high pressure use, the
34 turbulence and restrictions in internal air passages
35 and the air cap cause a loss of air speed and a
36 reduction in air volume. The result of this is low

1 paint transfer rates, poor atomization and an inferior
2 paint finish. However, transfer efficiency is
3 improved. If the air volume is increased while keeping
4 the pressure low, the ratio of air to paint increases
5 and the problems experienced with high pressure will
6 return depending on the increase in volume.

7
8 Existing high pressure spray guns have been modified to
9 operate at low pressures, but the complexity of the
10 designs and the intricate interconnecting drilled
11 passages do not permit good air flow. In an effort to
12 overcome the poor performance, air cap ring gaps were
13 increased, resulting in a substantial increase in air
14 consumption. This type of spray gun has become known
15 as the high volume-low pressure (HVLP) gun.

16
17 More specifically, in HVLP spray guns the means for
18 actuating the control valves within the gun have had
19 considerable shortcomings. For example, it is
20 commonplace for the stem of the needle valve and its
21 associated compression spring and housing to extend
22 through the main air flow passage to the nozzle,
23 thereby leading to significant restrictions in the air
24 flow path.

25
26 Likewise, in order to provide a convenient means for
27 actuating the stem of the air flow and fluid needle
28 valves, the main nozzle of the apparatus is mounted on
29 a forward projection of the apparatus so as to leave a
30 free space to accommodate the arc of movement of the
31 valve control trigger.

32
33 Moreover, since the same trigger operates both the
34 liquid and air control valves, the progressive control
35 from on to off operating characteristics of the air
36 control valve can be restricted in certain operating

1 conditions where the liquid control valve has been
2 manually adjusted to such a point that it affects the
3 ability of the trigger to operate both valves
4 simultaneously through the full range of movement.

5
6 The object of the present invention is to provide a
7 method and apparatus for spraying paint and other
8 surface treatment liquids, offering improvements in
9 relation to one or more of the matters discussed above,
10 or generally.

11
12 According to a first aspect of the invention there is
13 provided an apparatus for spraying liquid surface
14 treatment material, said apparatus having a housing, a
15 liquid inlet for supply of the liquid surface treatment
16 material, a gas inlet for supply of pressurised gas to
17 be mixed with the liquid surface treatment material, an
18 outlet nozzle through which the gas and liquid surface
19 treatment material is sprayed, a control valve adapted
20 to regulate the supply of the liquid surface treatment
21 material to the outlet nozzle, a gas valve operable
22 between an open position and a closed position, a first
23 communicating passageway connecting said gas inlet to
24 said gas valve, and a second communicating passageway
25 connecting said gas valve to said outlet nozzle;
26 wherein said second passageway is provided with a
27 stepped portion therein so that a gas vortex is created
28 therethrough.

29
30 Preferably, said second passageway is offset from said
31 first passageway. Preferably, said second passageway
32 is substantially conical in shape. Preferably, said
33 second passageway includes an inlet and an outlet,
34 wherein said passageway is tapered from said inlet to
35 said outlet. Preferably, said taper is between 1 and
36 15°.

1 Preferably, said stepped portion of said second
2 passageway comprises a ledge whose width tapers up to a
3 maximum of 10% of the radius of said second passageway
4 at the level of the stepped portion.

5
6 Preferably, said second passageway has a radius of
7 curvature at said outlet so as to provide gas to the
8 nozzle in a substantially horizontal direction.

9
10 Preferably, the longitudinal axis of said outlet nozzle
11 extends across said second passageway. Preferably, the
12 axis of symmetry of said ledge is offset from said
13 longitudinal axis of said outlet nozzle, thereby
14 inducing a vortex in the air flowing through said
15 passageway.

16
17 According to a second aspect of the invention there is
18 provided an apparatus for spraying liquid surface
19 treatment material, said apparatus having a housing, a
20 liquid inlet for supply of the liquid surface treatment
21 material, a gas inlet for supply of pressurised gas to
22 be mixed with the liquid surface treatment material, an
23 outlet nozzle through which the gas and liquid surface
24 treatment material is sprayed, a control valve adapted
25 to regulate the supply of the liquid surface treatment
26 material to the outlet nozzle, a gas valve operable
27 between an open position and a closed position, a first
28 communicating passageway connecting said gas inlet to
29 said gas valve, and a second communicating passageway
30 connecting said gas valve to said outlet nozzle;
31 wherein said second passageway is axially offset from
32 said first passageway and is substantially conical in
33 shape, and wherein said second passageway includes an
34 inlet and an outlet and is tapered from said inlet to
35 said outlet at an angle of taper of between 1 and 15°.
36

1 Preferably the apparatus further comprises a trigger
2 means, whereby said trigger means is adapted to operate
3 both of said control valve and said gas valve.

4
5 Preferably, said gas valve is an axially-sliding piston
6 valve. Preferably, said control valve is a liquid
7 control needle valve.

8
9 Preferably, said outlet nozzle is controlled by said
10 liquid control needle valve.

11
12 Preferably, said piston valve produces an annular air
13 jet in said second passageway. The piston valve may be
14 tapered or parallel. In addition, an air control valve
15 stem is provided which is connected to the piston valve
16 and operated by said trigger means.

17
18 Preferably, said piston valve comprises inner and outer
19 co-axial apertured sleeves, wherein said inner sleeve
20 is located within said outer sleeve and is rotatably
21 adjustable relative to said outer sleeve.

22
23 Preferably, the liquid control needle valve is
24 controlled by said trigger means via an axially-sliding
25 sleeve or slipper member situated on a rearward portion
26 of the housing. Preferably, it is also provided with a
27 rotational flow adjustment means to adjust the flow
28 rate of the liquid.

29
30 Preferably, said flow adjustment means comprises a stem
31 member, a rotational adjuster, and a return spring,
32 said stem member being threaded at its rearmost
33 extremity to accept the rotational adjuster.
34 Preferably, said stem member is actuated externally by
35 the trigger means, and is returned to its initial
36 position by a return spring.

1 Preferably, the apparatus further comprises a
2 regulating valve and a pair of side jets, whereby the
3 spray pattern of the outlet nozzle is regulated by said
4 regulating valve, and said side jets are utilised to
5 regulate said spray pattern.

6
7 Preferably, the needle valve is supplied with the paint
8 or material surface treatment liquid by a pressurized
9 material supply connector which distributes the
10 material via a radial port to said needle valve.
11 Alternatively, the material may be introduced to the
12 apparatus from a gravity liquid reservoir fitted to the
13 uppermost aspect of the apparatus via a radial port.

14
15 According to a third aspect of the present invention,
16 there is provided a method of spraying a fluid onto a
17 surface, said method comprising the steps of:

18 supplying a liquid to be sprayed into a liquid
19 inlet of a spray apparatus;

20 supplying a pressurised gaseous propellant into a
21 gas inlet of said spray apparatus;

22 passing said gaseous propellant through a
23 communicating passageway from said gas inlet to an
24 outlet nozzle;

25 accelerating said gaseous propellant by creating a
26 gas vortex as said propellant passes through said
27 communicating passageway;

28 passing said accelerated propellant through an
29 outwardly tapering portion of the communicating
30 passageway to further accelerate the vortex and supply
31 the propellant to the outlet nozzle in the form of an
32 annular gas jet; and

33 spraying said liquid onto a surface by mixing said
34 liquid and said annular gas jet at said nozzle.

35
36 Preferably, said passageway comprises an upper portion

1 and a lower portion, wherein said upper portion is
2 axially offset from said lower portion and is
3 substantially conical in shape. Preferably, said upper
4 portion of said passageway includes an inlet and an
5 outlet and is tapered from said inlet to said outlet at
6 an angle of taper of between 1 and 15°.

7
8 Preferably, the mixing of said liquid and said annular
9 gas jet is controlled by a trigger valve mechanism on
10 said spray apparatus. Preferably, said trigger valve
11 mechanism comprises:

12 a gas valve operable between an open position and
13 a closed position;

14 a control valve adapted to regulate the supply of
15 the liquid to be sprayed; and

16 a trigger means;

17 whereby said trigger means is adapted to operate
18 both of said gas and control valves.

19
20 Preferably, said control valve is a liquid control
21 needle valve. Preferably, said gas valve is an
22 axially-sliding piston valve. Preferably said piston
23 valve comprises an inner apertured sleeve and an outer
24 apertured sleeve, said inner and outer sleeves being
25 co-axial, and wherein said inner sleeve is located
26 within said outer sleeve and is rotatably adjustable
27 relative to said outer sleeve.

28
29 Embodiments of the invention will now be described by
30 way of example with reference to the accompanying
31 drawings in which :-

32
33 Figure 1 shows a first embodiment of a spray gun
34 according to the present invention;

35
36 Figure 2 shows a section through the spray gun of

1 Figure 1 having pressure feed and offset air passages;
2

3 Figure 3 shows a second embodiment of a spray gun
4 according to the present invention;

5
6 Figure 4(a) shows a section through the spray gun of
7 Figure 3 having offset air passages and a tapered upper
8 air passage;

9
10 Figure 4(b) is a sectional view along line "A-A" of
11 Figure 4(a);

12
13 Figure 4(c) is a sectional view along line "B-B" of
14 Figure 4(a), showing the stepped portion of the upper
15 air passage;

16
17 Figure 5 shows a third embodiment of a spray gun
18 according to the present invention;

19
20 Figure 6(a) shows a section through the spray gun of
21 Figure 5;

22
23 Figure 6(b) shows the component parts of the piston
24 valve of the spray gun of Figures 5 and 6(a); and

25
26 Figure 6(c) shows a sectional view along line "VI-VI"
27 of Figure 6(a).

28
29 As shown in Fig 1, a first embodiment of a spray
30 apparatus 10 comprises a body or housing 12 having a
31 nozzle 14, an operating trigger 40, and a regulating
32 valve 52. Nozzle 14 is secured to the housing 12 by a
33 threaded ring 11.

34
35 Figure 2 shows a section view through the spray gun
36 which shows the components of the apparatus 10 in more

1 detail. The apparatus 10 has an air supply connection
2 16, a pressurized material supply connection 18, an air
3 control valve stem 20, and a liquid control valve 22.
4 It will be noticed that in this embodiment, and each of
5 the subsequent embodiments described herein, the air
6 supply connection 16 and material supply connection 18
7 and their respective supply passages are located in the
8 handle portion of the apparatus 10. By locating both
9 supply connections 16, 18 in the handle portion, the
10 apparatus 10 can be packaged in a more compact manner
11 than prior art apparatus. Furthermore, by being
12 located in the handle the supply passages are free from
13 the internal restrictions which can hamper the
14 performance of known apparatus.

15
16 A tapered piston valve 23 controls the supply of air to
17 the nozzle 14 in order to regulate the spray pattern.
18 The nozzle 14 provides a central jet 15 controlled by
19 the liquid control needle valve 22, and an annular air
20 jet 28 controlled by the piston valve 23. The air
21 control valve stem 20 connects to an axially-sliding
22 piston 24 to effect progressive throttling of the air
23 flow. The stem 20 is pushed by an operating trigger
24 40.

25
26 The air supply connection 16 is coupled to a compressor
27 (not shown) which provides air under pressure to the
28 air supply connection 16. Connection 18 is supplied by
29 a reservoir (not shown) containing paint or like
30 material to be sprayed.

31
32 The liquid control needle valve 22 has a rotational
33 adjuster 44 and is controlled by the trigger 40 through
34 a sleeve member 46 which slides on a rearward portion
35 48 of the housing 12. The trigger 40 acts on the
36 sleeve 46 by way of a flange (not shown) on the sleeve

1 46, thereby opening the needle valve 22 to allow liquid
2 to pass through.

3
4 A regulating valve 52 is positioned whereby the jet 15
5 produced by nozzle 14 is regulated from a natural cone
6 to a fan pattern by air from side jets 17.

7
8 The air passage 38 connects the air supply connection
9 16 with the piston valve 23. The air control valve
10 stem 20 controls the air flow through a pair of offset
11 passages 38 and 39, where the lower passage 38 and the
12 upper passage 39 are offset to create a vortex within
13 the upper passage 39, thereby accelerating the gas flow
14 through said upper passage 39. A return spring 25 is
15 also provided in order to return the piston 24 and stem
16 20 to their extended position when released. The
17 piston valve 23 has two apertured rotational sleeves 26
18 which can be adjusted by a lever 21 to either line up,
19 close off or partially close the apertures, thereby
20 increasing or decreasing the vortex in the passage 39.
21 Thus, the pressure in the gun can be regulated to offer
22 variable pressure sprays. A more detailed description
23 of the operation of the piston valve 23 is given later.

24
25 The liquid control valve needle 22 has a stem member 42
26 which passes through sleeve member 46 and is threaded
27 at its rearmost extremity to accept the rotational
28 adjuster 44. The rotational adjuster 44 allows fine
29 position adjustment of the fluid control needle 22.
30 Trigger 40 actuates the needle member 22 externally of
31 the housing 12. An internal return spring (not shown)
32 returns the needle 22 to its rest position. Liquid to
33 be sprayed is fed to the needle valve 22 from
34 connection 18 via a radial port 56.

35
36 Figure 3 shows a second embodiment of a spray gun

1 apparatus 10 according to the present invention.
2 Externally, the second embodiment appears similar to
3 the apparatus of the first embodiment. However, the
4 sectional views of Figures 4(a)-(c) highlight the
5 difference between the two embodiments.

6
7 Figures 4(a)-(c) show views of the second embodiment of
8 the spray gun 10 in which upper air passage 39 has been
9 modified to assist the creation of the vortex within
10 the upper passage 39. Figure 4(b) shows the tapering
11 of the upper passage 39 to assist the acceleration of
12 the gas therein. The best acceleration results have
13 been produced when the tapering is between 0 and 10°.
14 Figure 4(c) shows the cross-section B-B of the upper
15 passage 39 at its inlet, wherein a stepped portion 50
16 is provided. For the most effective vortex, the
17 stepped portion 50 should encompass approximately 10%
18 of the circumference of the upper passage 39.

19
20 The vortex is created in the upper passage 39 as the
21 gas passes through the inlet of upper passage 39 over
22 the stepped portion 50, which can be best seen in Fig
23 4(b). As the gas passes over the stepped portion 50,
24 the increased area causes the gas to swirl in the
25 passage, thereby creating the vortex which produces a
26 gas acceleration upwards through the upper passage 39.
27 The tapering of the upper passage 39 ensures that the
28 vortex is sustained until it reaches the outlet of the
29 upper passage 39 at nozzle 14.

30
31 As with each of the embodiments described herein, the
32 liquid control valve needle 22 passes through the
33 uppermost chamber 51 of the upper passage 39. This is
34 best seen in Figure 4(b), where the valve 22 passes
35 directly through the chamber 51 in such a way as to not
36 hinder the vortex created in the upper passage 39.

1 Thus, the vortex flows through the chamber 51
2 relatively unhindered by the valve 22 as the gas flows
3 around the outside of the valve 22, and the vortex is
4 not destroyed by the valve 22.

5
6 Aside from the amendments to the passage 39, this
7 embodiment of the spray gun 10 is constructed and
8 operated substantially in the same manner as the spray
9 gun 10 of figure 1.

10
11 The third and final of the preferred embodiments
12 described is shown in Figures 5 and 6(a)-(c). Again,
13 externally, the spray gun 10 is similar in appearance
14 to the other embodiments, with the majority of the
15 components previously described above being used.
16 However, the third embodiment differs in the operation
17 of the piston valve assembly 23 which produces the
18 vortex.

19
20 The use of a pair of apertured sleeves 26a,26b within
21 the piston valve assembly 23 was first discussed in the
22 description of the first embodiment above. However,
23 the individual components of the piston valve assembly
24 23 are best seen in Figure 6(b). The valve assembly 23
25 consists of an apertured outer sleeve 26b and an
26 apertured inner sleeve 26a, and each of the sleeves
27 26a,26b has a pair of apertures 61,62. On each sleeve
28 26a,26b, the apertures 61,62 are located diametrically
29 opposite one another, thereby permitting gas to pass
30 through the sleeves 26a,26b unhindered.

31
32 Figure 6(a) shows the manner in which the various
33 components of the valve assembly 23 co-operate. The
34 inner sleeve 26a is located inside the outer sleeve
35 26b, with the apertures 61,62 of the two sleeves
36 26a,26b being axially aligned to allow gas to pass

1 directly through the sleeves 26a,26b. The inner sleeve
2 26a is fitted with a lever 21 so that the inner sleeve
3 26a may be rotated relative to the outer sleeve 26b. A
4 return spring 25 is located within the sleeves 26a,26b
5 with a piston 24 positioned thereon. The piston 24
6 receives the spring 25 on one end 24a and an air
7 control valve stem 20 on the other end 24b. The stem
8 20 has a flange 20a which locates in the second end 24b
9 of the piston so that the stem 20 may act on the piston
10 24.

11
12 Thus, in order to operate the piston valve assembly 23,
13 the trigger 40 is pulled towards the housing 12 of the
14 apparatus 10. As the trigger 40 is pulled, it acts on
15 the valve stem 20 which in turn acts on the piston 24.
16 The action of the trigger 40 thus pushes the piston 24
17 away from the air passages, thereby permitting the gas
18 to pass through the valve assembly 23 by way of the
19 aligned apertures 61,62 in the inner and outer sleeves
20 26a,26b. When the trigger 40 is released, the spring
21 25 pushes the piston 24, stem 20, and trigger 40 back
22 to their original positions, and gas can therefore no
23 longer pass through the valve assembly 23.

24
25 Figure 6(c) shows how the alignment of the apertures
26 61,62 on the inner and outer sleeves 26a,26b can be
27 varied to improve the vortex generation in the upper
28 air passage 39. The lever 21 can be rotatably adjusted
29 in order to rotate the inner sleeve 26a relative to the
30 fixed outer sleeve 26b. Thus, as is seen in Figure
31 6(c), the apertures 61,62 can be offset from each
32 other. This offsetting of the apertures 61,62 creates
33 a lip portion 63, where a portion of the inner sleeve
34 26a partly blocks the aperture 61 of the outer sleeve
35 26b. Thus, the gas flowing through the valve assembly
36 23 is disrupted thereby creating the vortex in the

1 upper passage 39 of the apparatus 10.

2

3 In use, each of the embodiments is operated as follows:

4 The reservoir of material to be sprayed delivers the
5 material to central jet 15 under the control of needle
6 valve 22 where it is mixed with air delivered via air
7 passages 38 and 39. The operation of the gun is
8 initiated by trigger 40 operating air control valve
9 stem 20 and liquid control valve 22.

10

11 The present invention provides a method and apparatus
12 for spraying that addresses the limitations and
13 inefficiencies of prior spray guns. As it may operate
14 at pressures as low as 1.5psi in the air cap and at air
15 volumes as low as 4cfm, energy savings are achieved.
16 The very low pressures allow a very high transfer
17 efficiency to be achieved which is an added advantage
18 when used with paints containing volatile organic
19 compounds.

20

21 The present invention permits the trigger 40 to operate
22 the air control valve 23 and the fluid control valve 22
23 simultaneously, without restricting the operation of
24 either, regardless of the adjustment of the other. The
25 stems of both the fluid control needle valve 22 and air
26 control piston valve 23 operate in parallel to each
27 other, yet independently of each other.

28

29 The above permits a straight, unobstructed, large
30 diameter air passage 38 to the air valve 23 while also
31 permitting a short, straight air passage 39 to the air
32 cap 52 and a large diameter fluid passage.

33

34 In addition, by offsetting the air passages 38,39, gas
35 acceleration may be achieved by means of a vortex
36 created by the gas passing through these passages

1 38,39. With gas acceleration in the head portion of
2 the apparatus 10, the increased speed of the gas
3 created by the vortex leads to an increase in air speed
4 at the nozzle 14 and thereby an increase in material
5 sprayed by the gun. Therefore, although gas is
6 introduced to the apparatus 10 from a compressor at
7 relatively low pressure, by having the air passages
8 38,39 arranged in the offset position a gas
9 acceleration is achieved with a consequential increase
10 in efficiency at the nozzle 14. Moreover, the gas
11 acceleration is further improved by the provision of a
12 pair of adjustable, apertured sleeves 26a,26b which can
13 either increase or decrease gas flow into the vortex
14 from the air valve 23 depending on the alignment of the
15 apertures 61,62.

16

17 The features of the present invention:

- 18 i) reduce the compressed air volume required;
19 ii) reduce the pressure of said compressed air;
20 iii) reduce energy losses;
21 iv) improve exit air speed;
22 v) increase depression at the fluid nozzle; and
23 vi) reduce resistance to fluid flow.

24

25 The internal surface area of the air passages is
26 approximately 50% less than a representative selection
27 of spray guns currently available.

28

29 The trigger to air cap air passage length is 75% less
30 than with the representative selection.

31

32 Total air passage length is approximately 40% less than
33 with the representative selection.

34

35 Input air pressure is 75% lower than the average of the
36 representative selection.

1 Air volume required is approximately 50% lower than the
2 average of the representative selection.

3

4 Depression at the fluid nozzle is approximately 30%
5 greater than the representative selection.

6

7 These and other improvements and modifications can be
8 incorporated without departing from the scope of the
9 invention.

1 **CLAIMS:**

2

3 1. An apparatus for spraying liquid surface treatment
4 material, said apparatus comprising:

5 a housing;

6 a liquid inlet for supply of the liquid surface
7 treatment material;8 a gas inlet for supply of pressurised gas to be
9 mixed with the liquid surface treatment material;10 an outlet nozzle through which the gas and liquid
11 surface treatment material is sprayed;12 a control valve adapted to regulate the supply of
13 the liquid surface treatment material to the outlet
14 nozzle;15 a gas valve operable between an open position and
16 a closed position;17 a first communicating passageway connecting said
18 gas inlet to said gas valve; and19 a second communicating passageway connecting said
20 gas valve to said outlet nozzle;21 wherein said second passageway is provided with a
22 stepped portion therein so that a gas vortex is created
23 therethrough.

24

25 2. An apparatus according to Claim 1, wherein said
26 second passageway is offset from said first passageway.

27

28 3. An apparatus according to either Claim 1 or Claim
29 2, wherein said second passageway is substantially
30 conical in shape.

31

32 4. An apparatus according to any preceding claim,
33 wherein said second passageway includes an inlet and an
34 outlet, wherein said second passageway is tapered from
35 said inlet to said outlet.

36

1 5. An apparatus according to Claim 4, wherein said
2 taper is between 1 to 15°.

3
4 6. An apparatus according to either Claim 4 or Claim
5 5, wherein said second passageway has a radius of
6 curvature at said outlet so as to provide gas to the
7 outlet nozzle in a substantially horizontal direction.

8
9 7. An apparatus according to any preceding claim,
10 wherein said stepped portion of said second passageway
11 comprises a ledge whose width tapers up to a maximum of
12 10% of the radius of said second passageway at the
13 level of the stepped portion.

14
15 8. An apparatus according to Claim 7, wherein the
16 longitudinal axis of said outlet nozzle extends across
17 said second passageway.

18
19 9. An apparatus according to Claim 8, wherein the
20 axis of symmetry of said ledge is offset from said
21 longitudinal axis of said outlet nozzle.

22
23 10. An apparatus for spraying liquid surface treatment
24 material, said apparatus comprising:

25 a housing;

26 a liquid inlet for supply of the liquid surface
27 treatment material;

28 a gas inlet for supply of pressurised gas to be
29 mixed with the liquid surface treatment material;

30 an outlet nozzle through which the gas and liquid
31 surface treatment material is sprayed;

32 a control valve adapted to regulate the supply of
33 the liquid surface treatment material to the outlet
34 nozzle;

35 a gas valve operable between an open position and
36 a closed position;

1 a first communicating passageway connecting said
2 gas inlet to said gas valve; and
3 a second communicating passageway connecting said
4 gas valve to said outlet nozzle;
5 wherein said second passageway is axially offset
6 from said first passageway and is substantially conical
7 in shape, and wherein said second passageway includes
8 an inlet and an outlet and is tapered from said inlet
9 to said outlet at an angle of taper of between 1 and
10 15°.

11

12 11. An apparatus according to any preceding claim,
13 further comprising a trigger means;

14 whereby said trigger means is adapted to operate
15 both of said control valve and said gas valve.

16

17 12. An apparatus according to Claim 11, wherein said
18 control valve is a liquid control needle valve.

19

20 13. An apparatus according to Claim 12, wherein said
21 gas valve is an axially-sliding piston valve.

22

23 14. An apparatus according to Claim 13, wherein said
24 outlet nozzle is controlled by said liquid control
25 needle valve.

26

27 15. An apparatus according to either Claim 13 or Claim
28 14, wherein said piston valve produces an annular air
29 jet in said second passageway.

30

31 16. An apparatus according to any of Claims 13 to 15,
32 further comprising an air control valve stem which is
33 connected to said piston valve and operated by said
34 trigger means.

35

36 17. An apparatus according to any of Claims 13 to 16,

1 wherein said piston valve comprises an inner apertured
2 sleeve and an outer apertured sleeve, said inner and
3 outer sleeves being co-axial, and wherein said inner
4 sleeve is located within said outer sleeve and is
5 rotatably adjustable relative to said outer sleeve.

6
7 18. An apparatus according to any of Claims 12 to 17,
8 wherein the liquid control needle valve is controlled
9 by said trigger means via an axially-sliding sleeve or
10 slipper member situated on a rearward portion of said
11 housing.

12
13 19. An apparatus according to any of Claims 12 to 18,
14 wherein said liquid control needle valve is provided
15 with a rotational flow adjustment means.

16
17 20. An apparatus according to Claim 19, wherein said
18 flow adjustment means comprises a stem member, a
19 rotational adjuster, and a return spring, said stem
20 member being threaded at its rearmost extremity to
21 accept said rotational adjuster.

22
23 21. An apparatus according to Claim 20, wherein said
24 stem member is actuated externally by said trigger
25 means, and is returned to its initial position by said
26 return spring.

27
28 22. An apparatus according to any of Claims 12 to 21,
29 wherein said liquid inlet comprises a pressurized
30 material supply connector, and wherein said needle
31 valve is supplied with a liquid by said pressurized
32 material supply connector.

33
34 23. An apparatus according to any of Claims 12 to 21,
35 wherein said liquid inlet comprises a gravity feed
36 liquid reservoir, and wherein said needle valve is

1 supplied with a liquid by said gravity liquid
2 reservoir.

3

4 24. An apparatus according to any preceding claim,
5 further comprising a regulating valve and a pair of
6 side jets, whereby the spray pattern of the outlet
7 nozzle is regulated by said regulating valve, and said
8 side jets are utilised to regulate said spray pattern.

9

10 25. A method of spraying a liquid onto a surface, said
11 method comprising the steps of:

12 supplying a liquid to be sprayed into a liquid
13 inlet of a spray apparatus;

14 supplying a pressurised gaseous propellant into a
15 gas inlet of said spray apparatus;

16 passing said gaseous propellant through a
17 communicating passageway from said gas inlet to an
18 outlet nozzle;

19 accelerating said gaseous propellant by creating a
20 gas vortex as said propellant passes through said
21 communicating passageway;

22 passing said accelerated propellant through an
23 outwardly tapering portion of the communicating
24 passageway to further accelerate the vortex and supply
25 the propellant to the outlet nozzle in the form of an
26 annular gas jet; and

27 spraying said liquid onto a surface by mixing said
28 liquid and said annular gas jet at said nozzle.

29

30 26. A method according to Claim 25, wherein said
31 passageway comprises an upper portion and a lower
32 portion, wherein said upper portion is axially offset
33 from said lower portion and is substantially conical in
34 shape.

35

36 27. A method according to Claim 26 wherein said upper

1 portion of said passageway includes an inlet and an
2 outlet and is tapered from said inlet to said outlet at
3 an angle of taper of between 1 and 15°.

4

5 28. A method according to any of Claims 25 to 27,
6 wherein the mixing of said liquid and said annular gas
7 jet is controlled by a trigger valve mechanism on said
8 spray apparatus.

9

10 29. A method according to Claim 28, wherein said
11 trigger valve mechanism comprises:

12 a gas valve operable between an open position and
13 a closed position;

14 a control valve adapted to regulate the supply of
15 the liquid to be sprayed; and

16 a trigger means;

17 whereby said trigger means is adapted to operate
18 both of said gas and control valves.

19

20 30. A method according to Claim 29, wherein said
21 control valve is a liquid control needle valve.

22

23 31. A method according to Claim 30, wherein said gas
24 valve is an axially-sliding piston valve.

25

26 32. A method according to Claim 31, wherein said
27 piston valve comprises an inner apertured sleeve and an
28 outer apertured sleeve, said inner and outer sleeves
29 being co-axial, and wherein said inner sleeve is
30 located within said outer sleeve and is rotatably
31 adjustable relative to said outer sleeve.

32

1 / 8

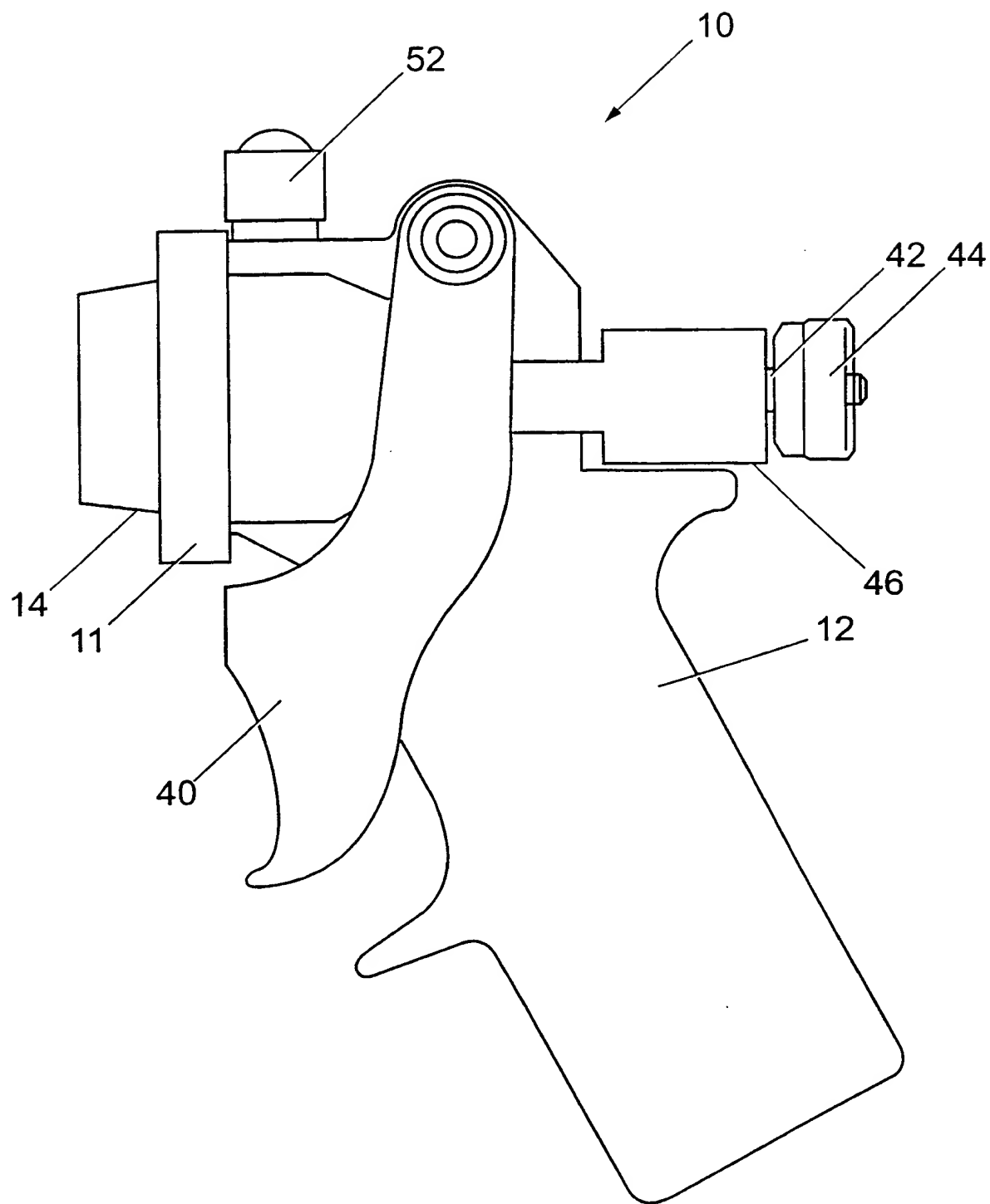


Fig. 1

2 / 8

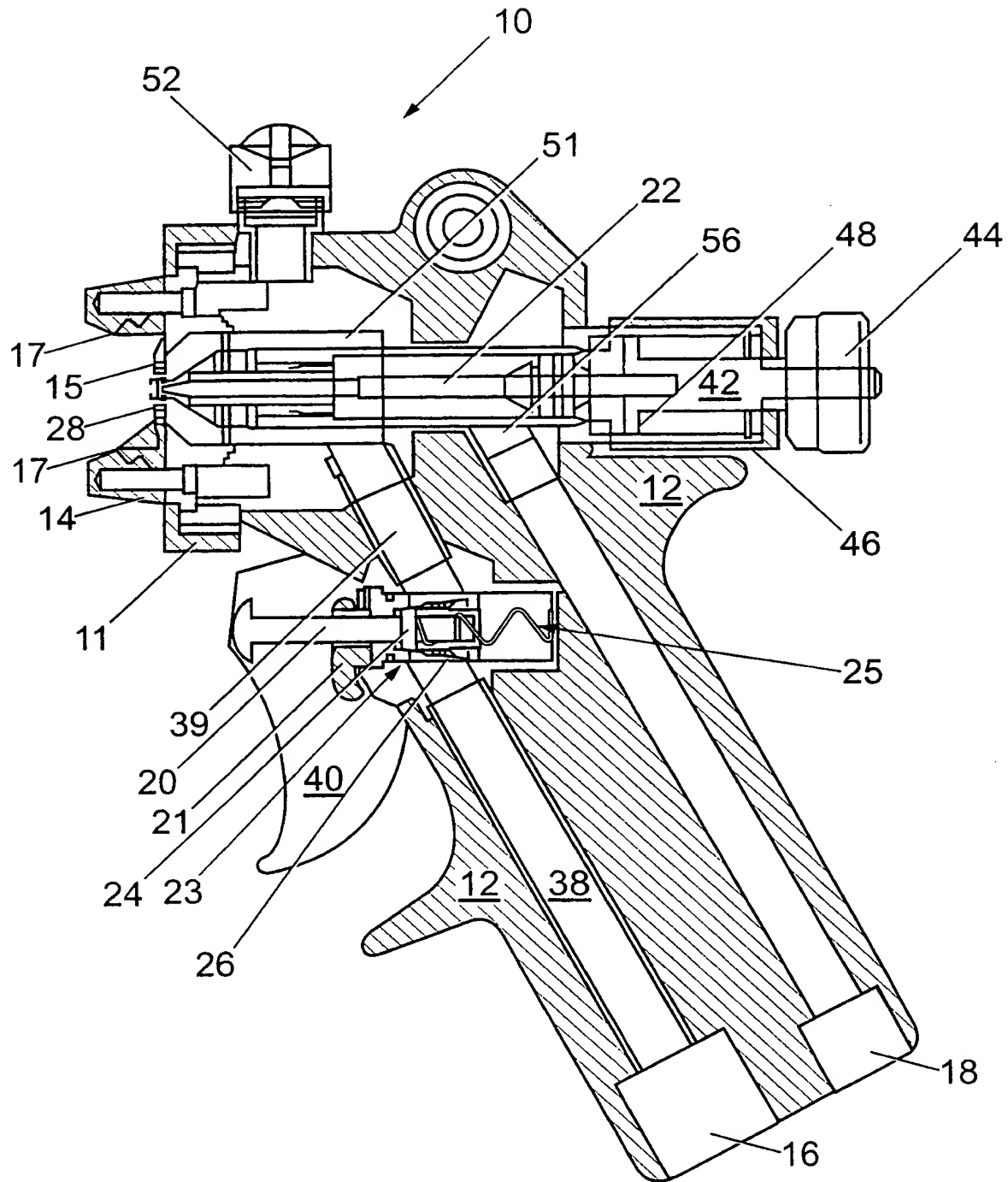
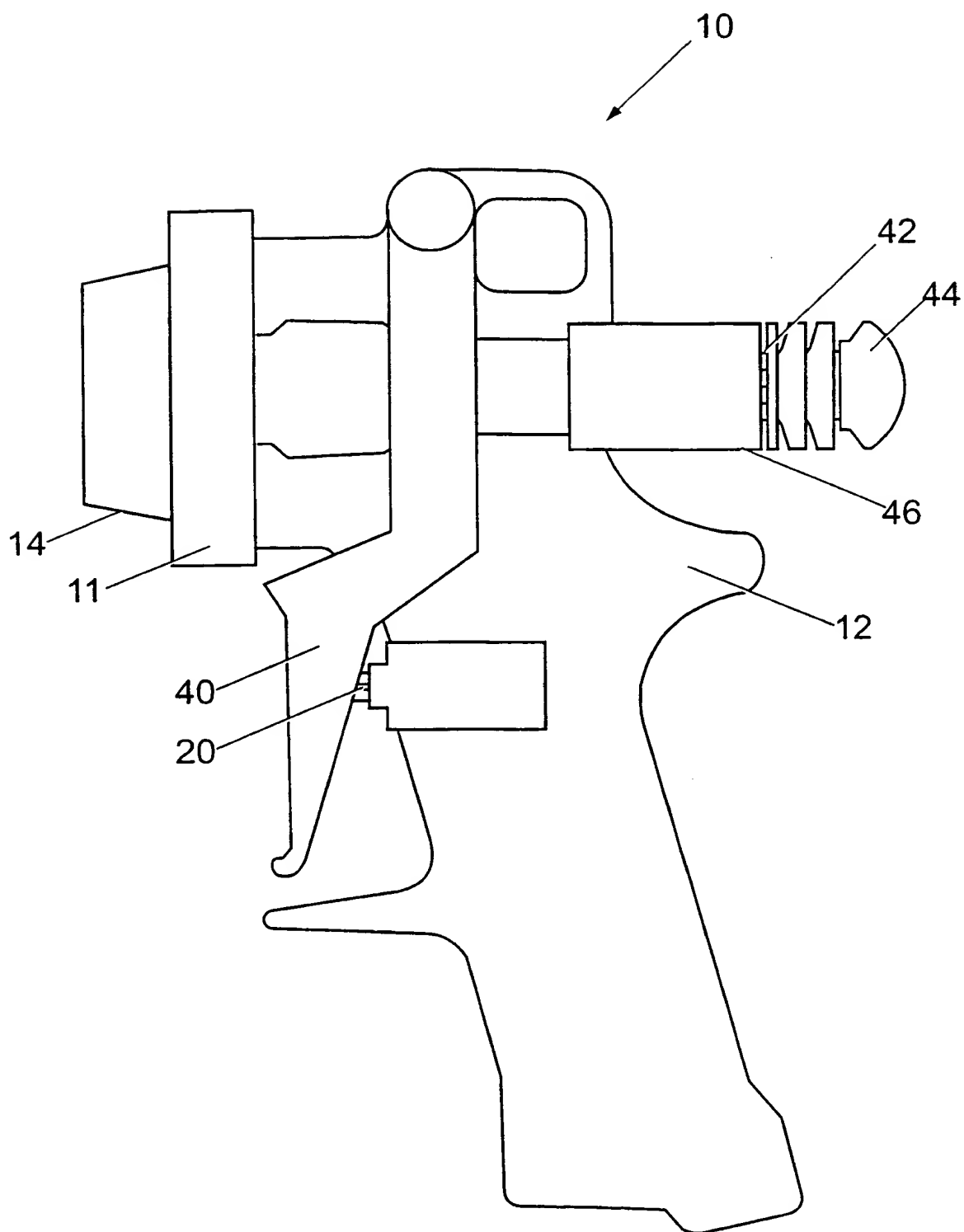


Fig. 2

3 / 8

*Fig. 3*

4 / 8

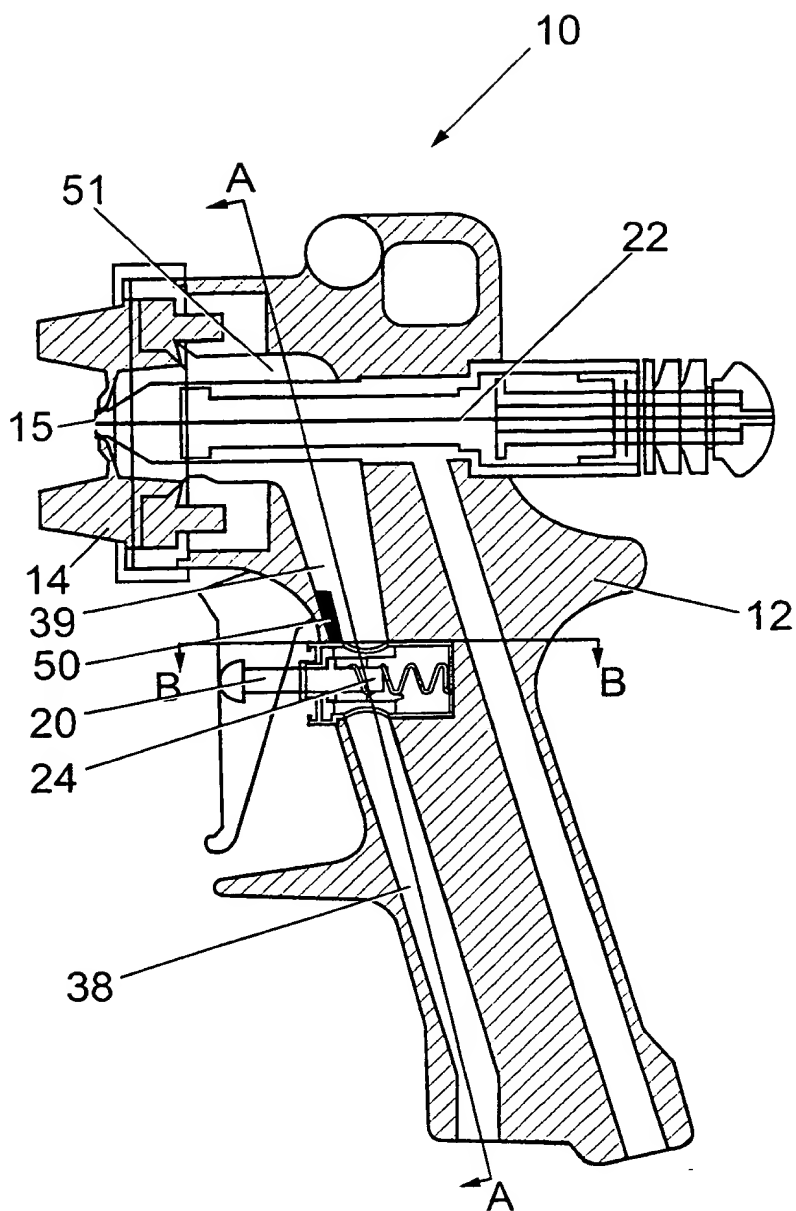


Fig. 4a

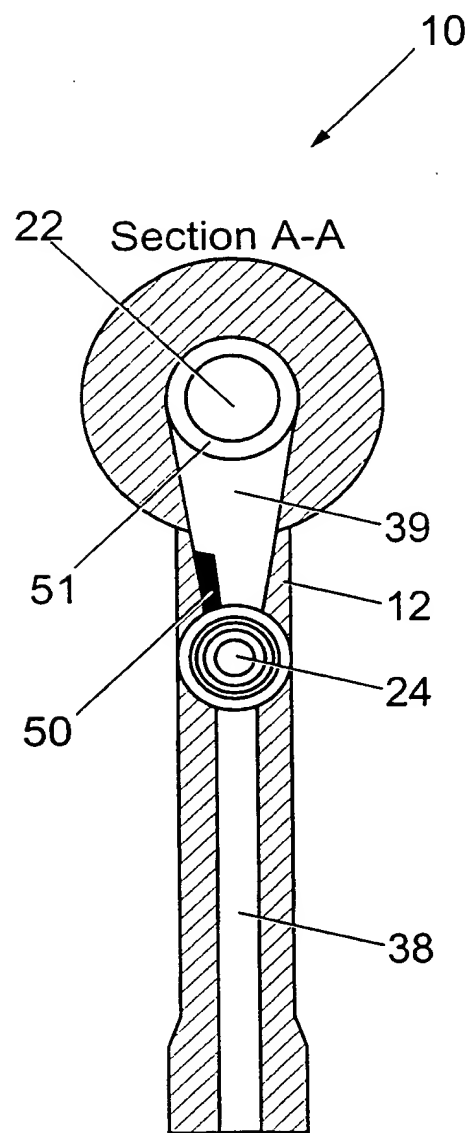


Fig. 4b

5 / 8

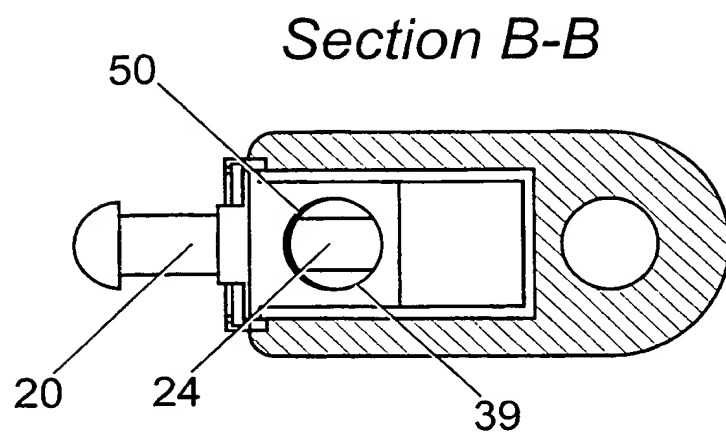
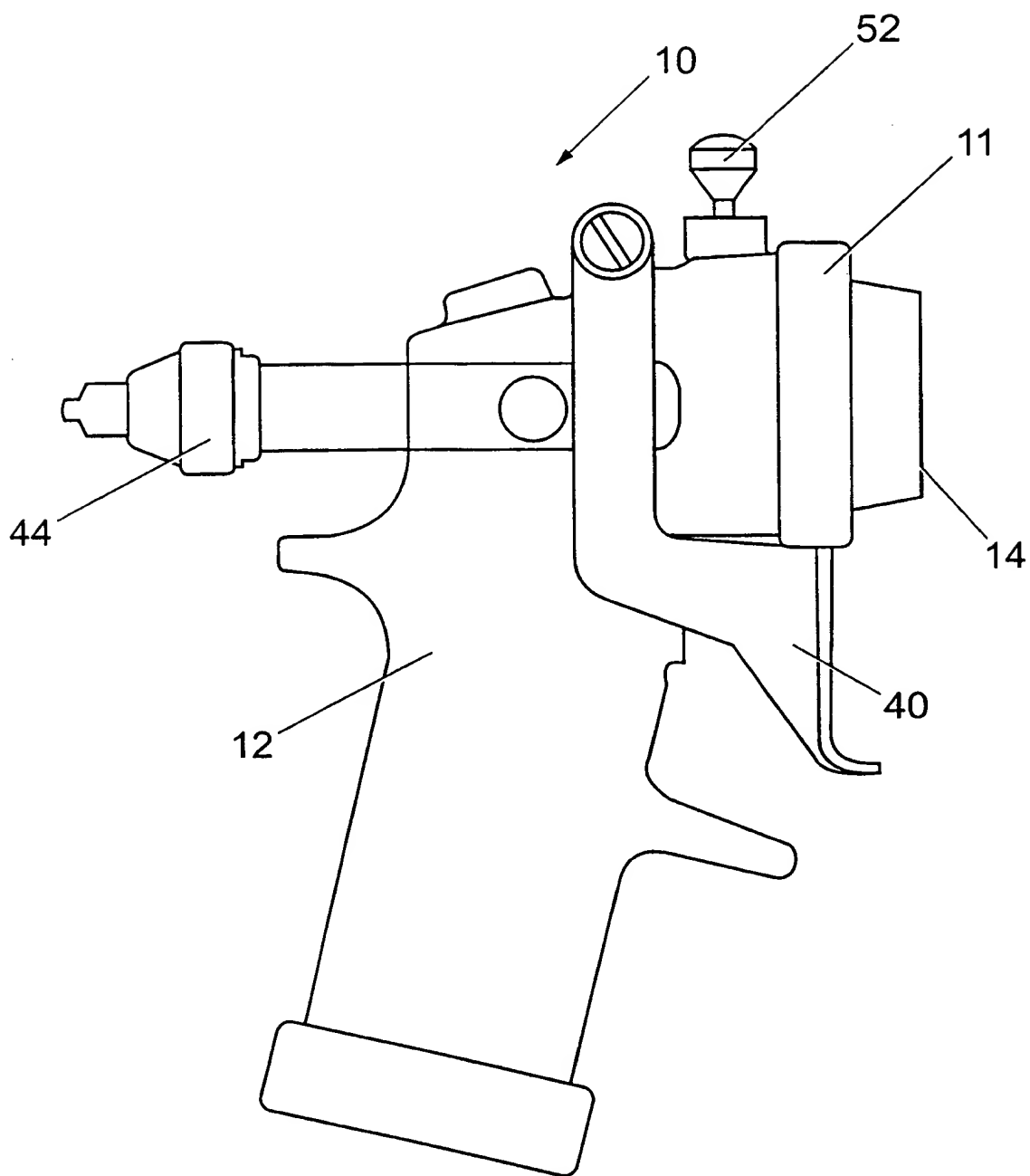
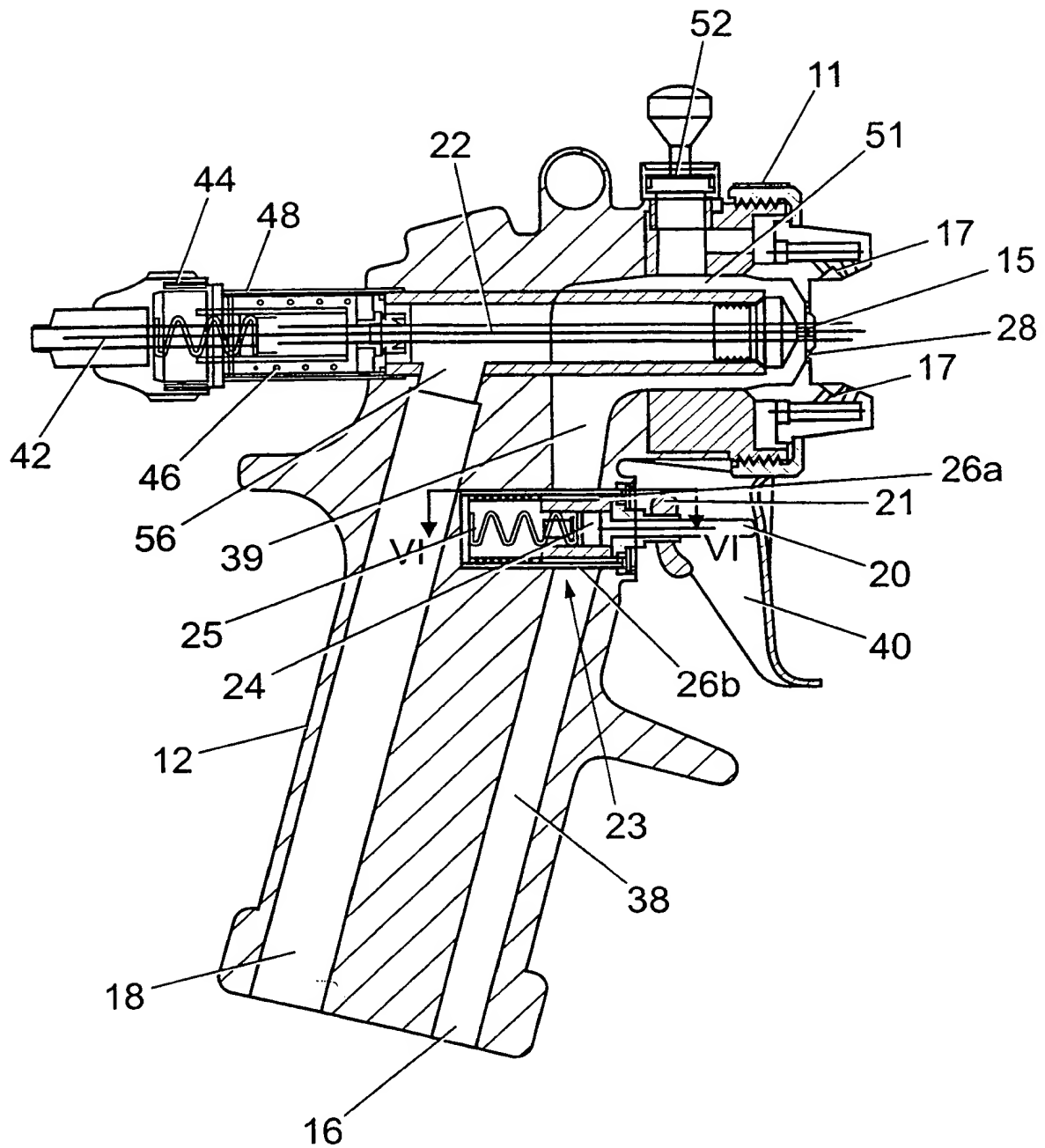


Fig. 4c

6 / 8

*Fig. 5*

7 / 8

*Fig. 6a*

8 / 8

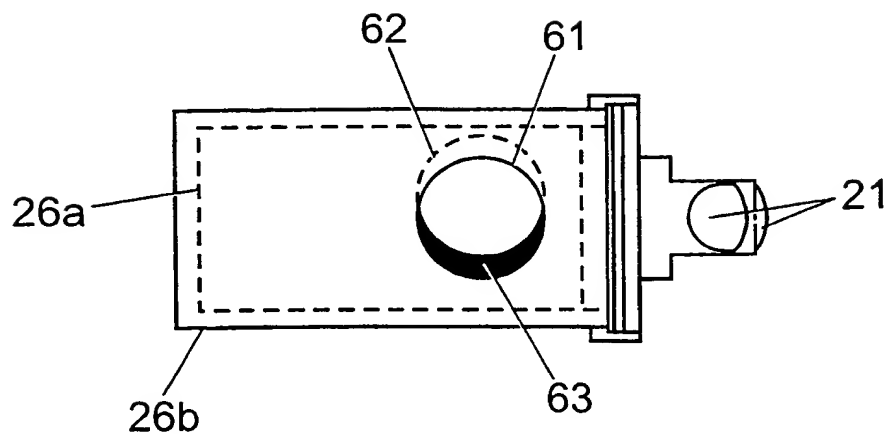
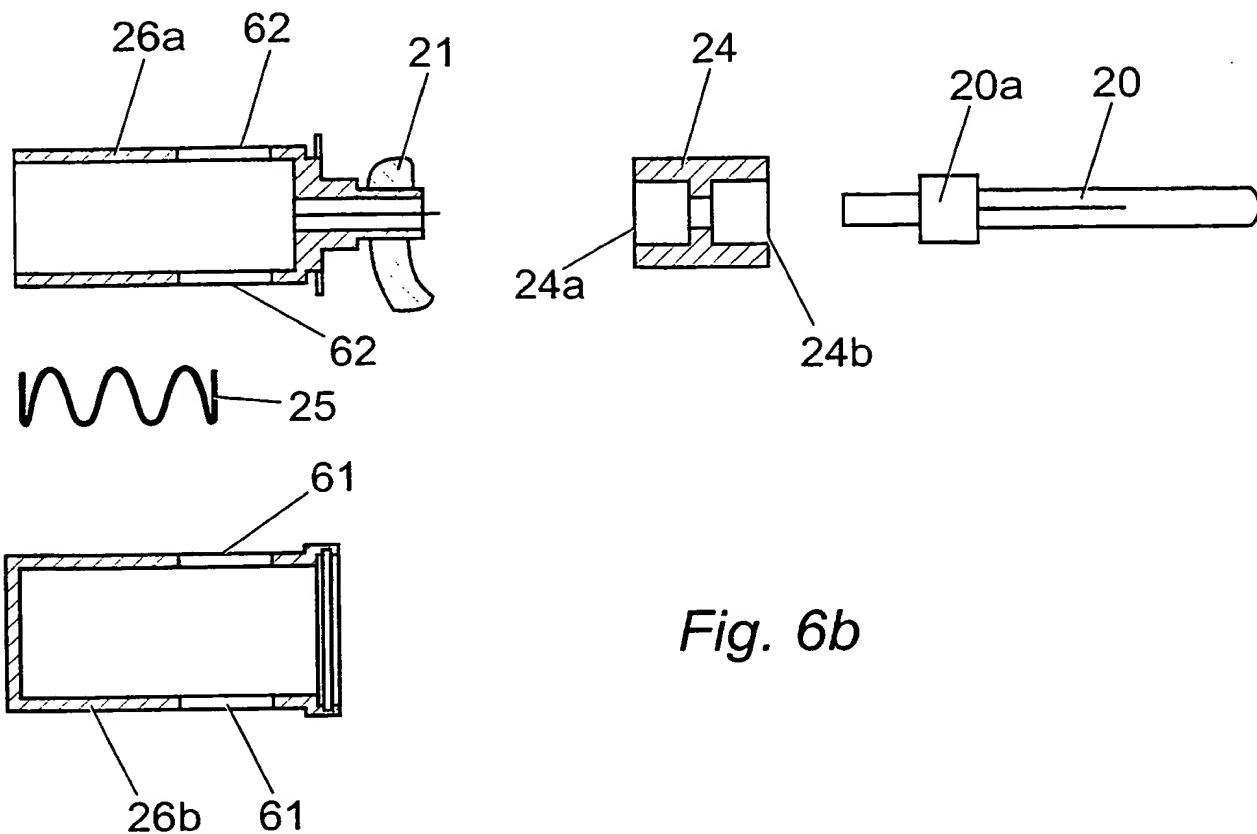


Fig. 6c

| | | |
|--|--|--|
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| <p>(21) International Application Number: PCT/GB99/03476</p> <p>(22) International Filing Date: 20 October 1999 (20.10.99)</p> <p>(30) Priority Data: 9823032.9 22 October 1998 (22.10.98) GB</p> <p>(71) Applicant (for all designated States except US): JIM LINDSAY LIMITED [GB/GB]; 13 Hill Street, Ardrossan KA22 8HE (GB).</p> <p>(72) Inventors; and (75) Inventors/Applicants (for US only): LINDSAY, James [GB/GB]; 25 Ardrossan Road, Saltcoats KA21 5BP (GB). ROBINSON, George, Walter [GB/GB]; 15 Shire Avenue, Spalding PE11 1FN (GB).</p> <p>(74) Agent: MURGITROYD & COMPANY; 373 Scotland Street, Glasgow G5 8QA (GB).</p> | <p>(81) Designated States: AE, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CR, CU, CZ, DE, DK, DM, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, US, UZ, VN, YU, ZA, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GW, ML, MR, NE, SN, TD, TG).</p> <p>Published <i>With international search report.</i></p> <p>(88) Date of publication of the international search report: 17 August 2000 (17.08.00)</p> | |
| <p>(54) Title: METHOD AND APPARATUS FOR SPRAYING</p> <p>(57) Abstract</p> <p>A low volume-low pressure spray gun (10) for spraying a fluid has a housing (12), a gas input (16), a trigger valve mechanism, and a nozzle (14). The gun (10) has lower and upper air passages (38, 39) which connect the gas input (16) to the trigger valve mechanism (23), and the trigger valve mechanism to the nozzle (14), respectively. The upper passage (39) is offset from the lower passage (38) and is substantially conical in shape, the layout of the passages (38, 39) producing a gas vortex in the upper passage (39) which creates a gas acceleration to compensate for the low pressure of the gas entering the gas input (16). The trigger valve mechanism comprises a piston valve (23), a liquid control needle valve (22), and a trigger (40). The piston valve (23) may include inner and outer apertured sleeves (26a, 26b), the sleeves being co-axial with the inner sleeve (26a) located inside the outer sleeve (26b). The inner sleeve (26a) is rotatably adjustable relative to the outer sleeve (26b) so that the apertures (61, 62) of the sleeves (26a, 26b) may be aligned, partially aligned, or closed, thus permitting adjustment of the gas vortex.</p> | | |
| | | |

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INTERNATIONAL SEARCH REPORT

International Application No.

GB 99/03476

A. CLASSIFICATION OF SUBJECT MATTER
 IPC 7 B05B7/10 B05B7/12

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
 IPC 7 B05B

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

| Category * | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
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| A | column 4, line 16 - line 45; figures 2, 3 | 5, 7, 12 |
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| A | abstract; figures 1, 3, 5 | |
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| A | abstract; figure 7 | 10, 24, 27, 29-32 |
| | column 3, paragraph 5 | |
| | --- -/- | |

☒ Further documents are listed in the continuation of box C.

☒ Patent family members are listed in annex.

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Date of the actual completion of the international search

25 May 2000

Date of mailing of the international search report

13. 06. 2000

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INTERNATIONAL SEARCH REPORT

Int. Patent Application No

PCT/GB 99/03476

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/GB 99/03476

Box I Observations where certain claims were found unsearchable (Continuation of Item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of Item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☒ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
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INTERNATIONAL SEARCH REPORT

International Application No. PCT/GB 99 03476

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claims: 1-9, 11-23

apparatus for spraying liquid with a gas and a liquid circuit, wherein a first passageway leads from the gas inlet to a gas valve and a second passageway connects the gas valve to the gas outlet and wherein the second passageway is provided with a STEPPED PORTION so that a gas vortex is created therethrough (claim 11-23 have been searched only as dependent on claims 1-9)

2. Claims: 10, 24-32

apparatus for spraying liquid with a gas and a liquid circuit, wherein a first passageway leads from the gas inlet to a gas valve and a second passageway connects the gas valve to the gas outlet and wherein the second passageway is axially OFFSET from the first passageway, and is CONICAL in shape, and is TAPERED between the inlet and the outlet of said passageway at an angle of taper of between 1 and 15°;

Method of spraying using such a tapering portion

INTERNATIONAL SEARCH REPORT

Information on patent family members

In. International Application No

PCT/GB 99/03476

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